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Photosynthesis genes in marine viruses yield proteins during host infection

Debbie Lindell[1], Jacob D. Jaffe[2,4], Zackary I. Johnson[1,4], George M. Church[2] & Sallie W. Chisholm[1,3]

1. Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
2. Department of Genetics, Harvard Medical School, Boston, Massachusetts 02115, USA
3. Department of Biology, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
4. †Present addresses: The Broad Institute of Harvard and MIT, Cambridge, Massachusetts 02141, USA (J.D.J); Department of Oceanography, University of Hawaii, 1000 Pope Road, Honolulu, Hawaii 96822, USA (Z.I.J.)

Correspondence to: Sallie W. Chisholm[1,3] Correspondence and requests for materials should be addressed to S.W.C. (Email: chisholm@mit.edu).

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Cyanobacteria, and the viruses (phages) that infect them, are significant contributors to the oceanic 'gene pool'[1, 2]. This pool is dynamic, and the transfer of genetic material between hosts and their phages[3, 4, 5, 6] probably influences the genetic and functional diversity of both. For example, photosynthesis genes of cyanobacterial origin have been found in phages that infect *Prochlorococcus* [5, 7] and *Synechococcus* [8, 9], the numerically dominant phototrophs in ocean ecosystems. These genes include *psbA*, which encodes the photosystem II core reaction centre protein D1, and high-light-inducible (*hli*) genes. Here we show that phage *psbA* and *hli* genes are expressed during infection of *Prochlorococcus* and are co-transcribed with essential phage capsid genes, and that the amount of phage D1 protein increases steadily over the infective period. We also show that the expression of host photosynthesis genes declines over the course of infection and that replication of the phage genome is a function of photosynthesis. We thus propose that the phage genes are functional in photosynthesis and that they may be increasing phage fitness by supplementing the host production of these proteins.

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